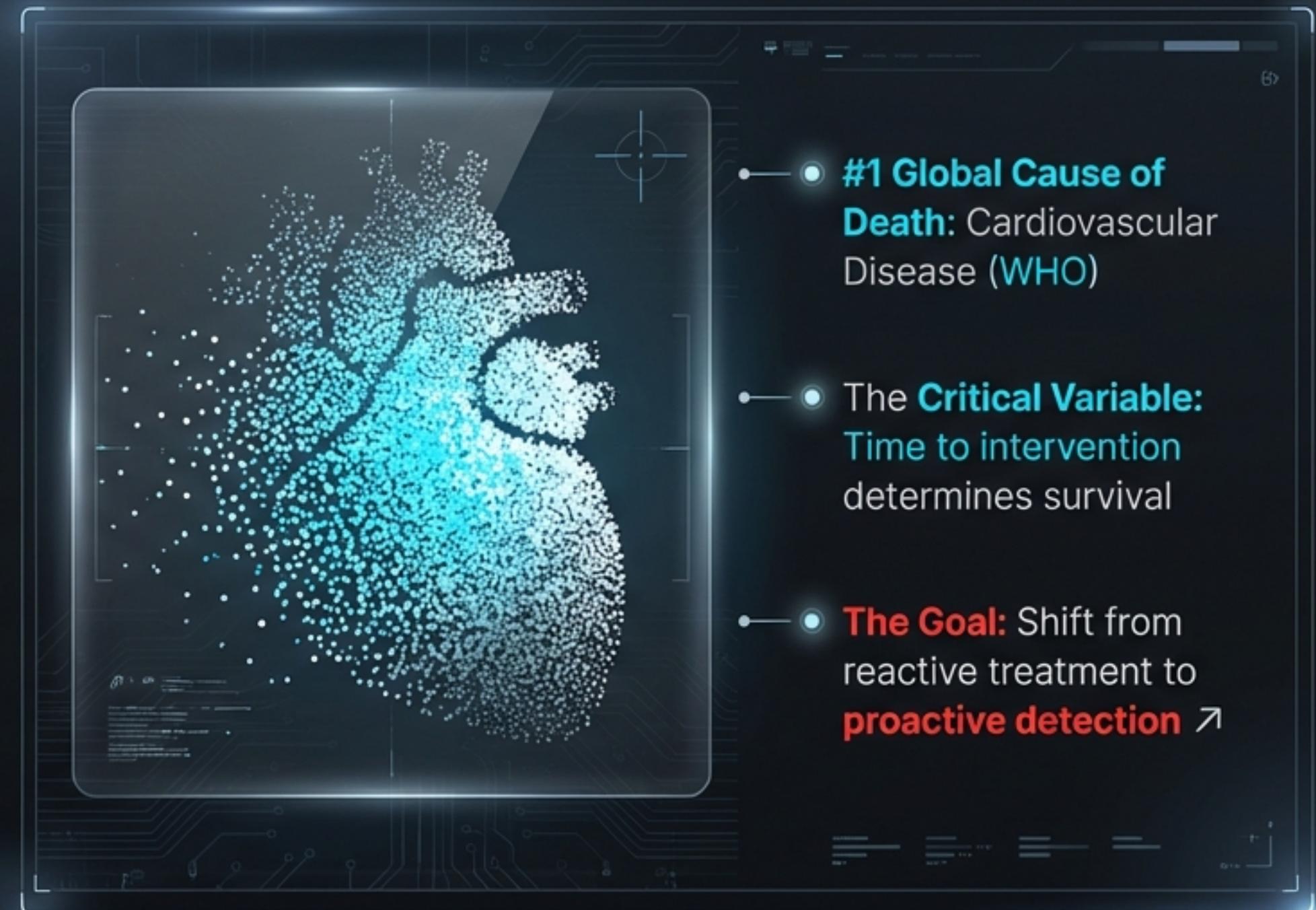


# IntelliHeart Pro

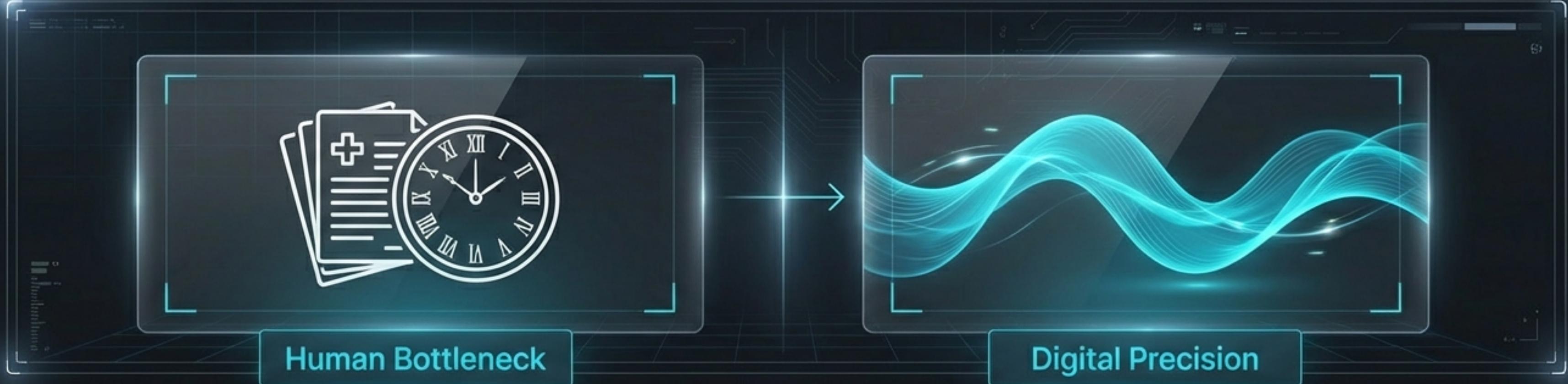
## Deep Learning Cardiac Monitoring

Real-Time Arrhythmia Detection & Signal Analysis

# The Silent Global Burden



# The Limits of Manual Surveillance



## Resource Scarcity

Severe shortage of specialists in underserved areas.

## Cognitive Fatigue

Attention degrades during long-term monitoring.

## Latency

Critical delays between event and diagnosis.

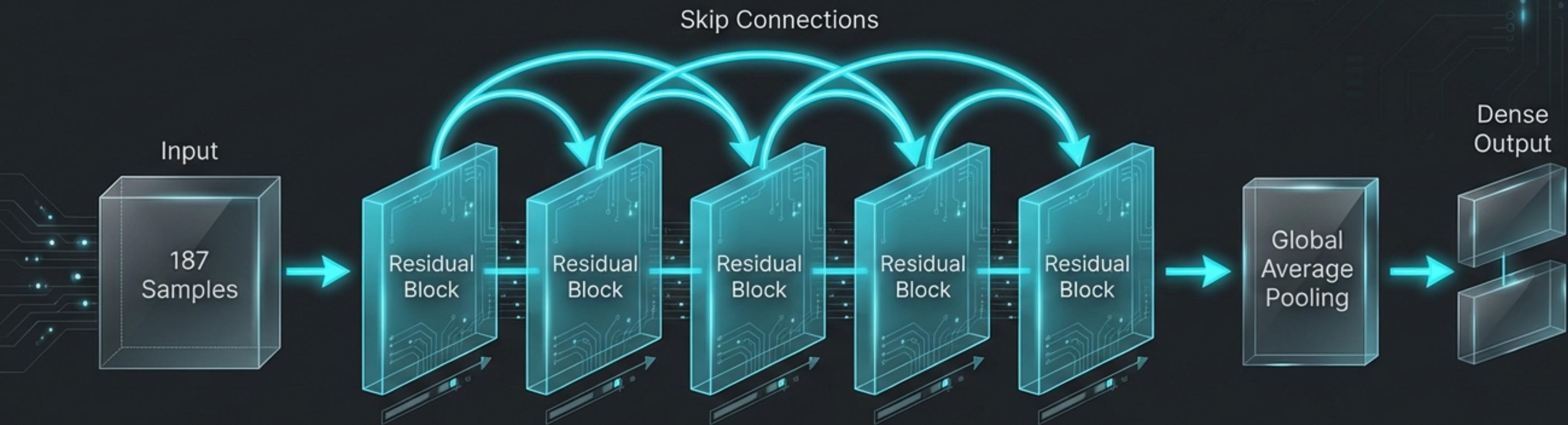
# Intelligence at the Edge

**Automated Classification**  
Distinguishes normal vs. abnormal beats with ~98% accuracy.

**Continuous Surveillance**  
24/7 monitoring without fatigue or degradation.

**Immediate Alerting**  
Audio-visual feedback system for instant notification.

# Architecture: Deep Residual CNN



- ⇒ **ResNet-Inspired:** 5 Residual Blocks with skip connections to solve vanishing gradients.
- ⇒ **1D Convolutions:** Optimized specifically for temporal signal processing.
- ⇒ **Input Normalization:** Sample-wise standardization (StandardScaler).

# Powered by Clinical Data

## MIT-BIH Arrhythmia Database



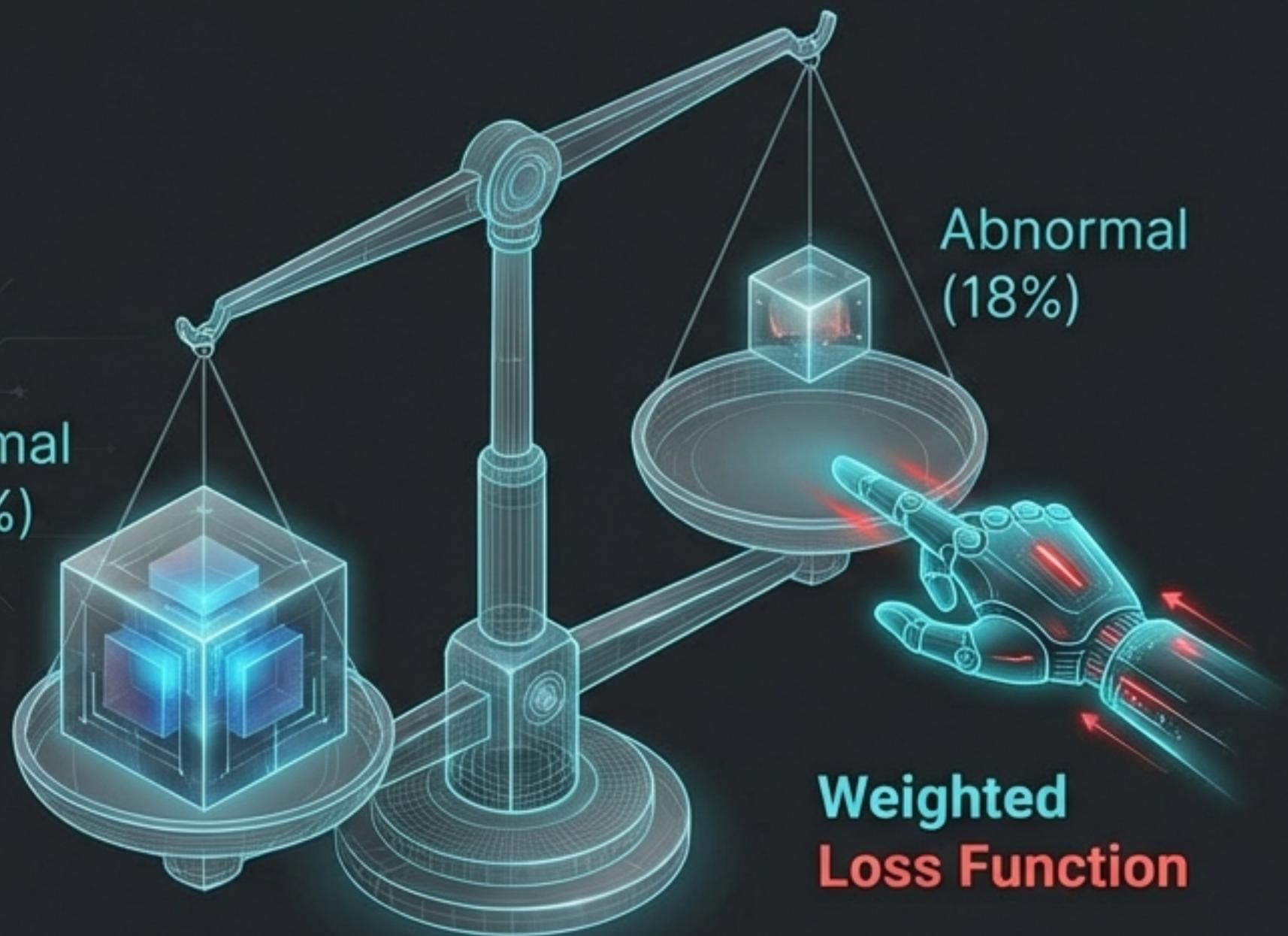
## PTB Diagnostic Database

109,446+

Distinct Heartbeats Processed

- **Source:** PhysioNet Gold-Standard Clinical Data
- **Preparation:** Rigorous preprocessing to handle noise and artifacts.

# Engineering Around Bias



- **The Challenge:** Dataset dominated by Normal beats (~82%).
- **The Risk:** Model bias toward majority class (**False Negatives**).
- **The Fix:** Implemented `compute_class_weight` to force equal learning from minority samples.

# Performance Metrics & Safety Logic



Test Accuracy



Sensitivity (Recall)



Inference Speed

Philosophy: 'Safety First' — prioritizing sensitivity to minimize missed events.

# The Clinician's Interface

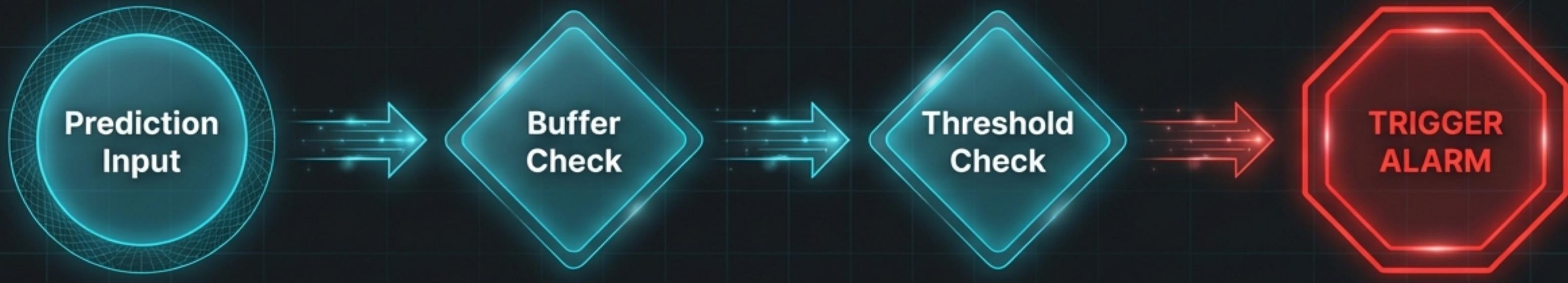


Live Telemetry:  
Real-time waveform  
with grid.

Visual Hierarchy:  
Immediate status  
recognition.

Cognitive Load:  
Minimalist design  
to prevent overload.

# Mitigating Alert Fatigue



Are there 2+ consecutive  
abnormal beats?

Is probability > 0.2?

- **Consecutive Buffering:** Filters transient noise.
- **Adaptive Thresholds:** Default 0.2 for high-risk patients.
- **Contextual Audio:** Distinct sounds for events vs. alarms.

# Deployment & Stack



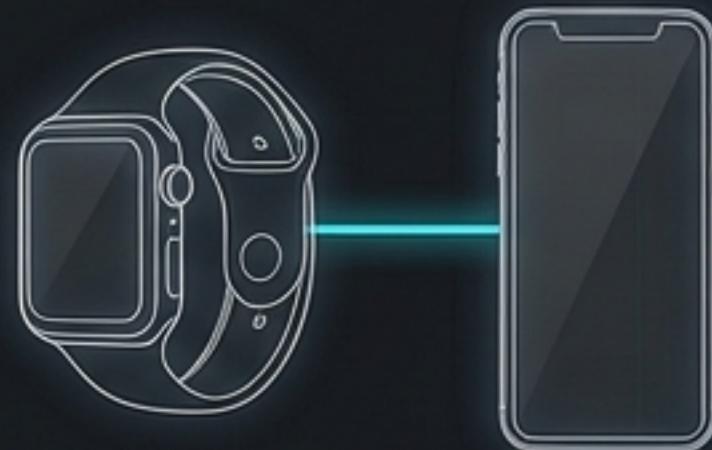
Python



TensorFlow 2.x



Streamlit  
Streamlit



## Current State

### Local Inference

- **Current:** Local Streamlit deployment for privacy.
- **Optimization:** Batch-free single-sample prediction pipeline.

## Future State

### Edge/Mobile Inference

- **Strategy:** Architected for future migration to Edge devices.

# Vision: From Code to Clinic



**Phase 1:**  
Binary Classification  
& Dashboard

**Phase 2:**  
Multi-class  
Arrhythmia Detection

**Phase 3:**  
TensorFlow Lite  
Mobile Optimization

**Phase 4:**  
Wearable Device  
Integration

# Principles & Limitations



## Research Only

Not a certified medical device.



## Transparency

Open architecture and documented limits.



## Scientific Rigor

Based on peer-reviewed methodologies.



# Democratizing Cardiac Intelligence

- **The Mission:** Enable ubiquitous, intelligent cardiac care.
- **The Outcome:** Saving lives through early detection.
- **IntelliHeart Pro:** Advancing AI in Healthcare.



SYSTEM STATUS: ACTIVE MONITORING

DATA SOURCE: GLOBAL HEALTH REGISTRIES 2024



NotebookLM